Abstract of the Disclosure

A particle filter is employed so that particle locations provide signal information to construct an approximated conditional distribution of probabilistic signal state. For an optimal tracking filter, current particles are used with weight value of one for each. To construct an optimal predicting filter, a copy of the current particles are evolved forward to the time for which the prediction is to occur. A new branching particle method allows the construction of optimal smoothing filters. Ancestor particles retain probabilistic data about the likely historical path of the signal. Then these particles, weighted by their associated ancestor particle weights, provide the approximate asymptotically optimal conditional distribution of the signal state at the collection of previous times. The branching particle filter operates recursively on the observation data, allowing real-time operation of the system. It is asymptotically optimal in increasing numbers of particles and in a decreasing period of time between observations, but the rate of convergence with regards to the observation period is extremely fast.